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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Lloyd Christopher Leonard Hollenberg

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WOOD, PHILLIPS, KATZ, CLARK & MORTIMER

500 W. MADISON STREET

SUITE 3800

CHICAGO, IL 60661

EXAMINER

KIM, JAY C

ART UNIT

PAPER NUMBER

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/524,951	Applicant(s) HOLLENBERG ET AL.	
	Examiner JAY C. KIM	Art Unit 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 July 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) 20-27 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 February 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>2/18/05</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This Office Action is in response to the Application filed February 18, 2005.

Election/Restrictions

1. Applicants' election with traverse of Group I and Species I, claims 1-19, in the reply filed on July 28, 2008 is acknowledged. The traversal is on the ground that claim 25 depends on any one of claims 1-22. This is not found persuasive because Groups I -V lack the same or corresponding special technical features, because the common features as set forth in claim 1 do not show an inventive concept over the prior art as evidenced by Fig. 3 of Kane (US 6,369,404), which shows all the limitations of claim 1, but not all the limitations of claim 25. Claims 20-22 are withdrawn from further consideration as being drawn to a nonelected Species, because Species I is directed to Fig. 1(a). Claims 23-27 are withdrawn from further consideration as being drawn to nonelected inventions. The requirement is still deemed proper and is therefore made FINAL.

Claim Objections

2. Claim 3 is objected to because of the following informalities: on line 2, "the" should be inserted before "other". Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

Art Unit: 2815

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 2-4, 8 and 19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 2, it is not clear whether “donor electrons” should be replaced by “donor atoms”, because electrons cannot ionise.

Regarding claim 3, it is not clear whether “a charge qubit” recited in claim 3 refers to “a charge qubit” recited in claim 1. In the below prior art rejection, it is interpreted that “a charge qubit” recited in claim 3 refers to “a charge qubit” recited in claim 1.

Regarding claim 4, it is not clear what “the charge qubit is formed the lowest symmetric or antisymmetric molecular states” refer to, because some words are missing.

Regarding claim 8, it is not clear whether “the two P atoms are buried in the range 5 to 50nm” refer to a depth or separation from each other.

Regarding claim 19, it is not clear whether “it” refer to the device or the environment. In the below prior art rejections, it is interpreted that “it” refers to the device.

5. Claim 1 recites the limitation "the location" in a quantum device. There is insufficient antecedent basis for this limitation in the claim. Claims 2-19 depend on claim 1, and therefore claims 2-19 are also indefinite.

Art Unit: 2815

6. Claim 4 recites the limitation "the lowest symmetric or antisymmetric molecular states" in a quantum device. There is insufficient antecedent basis for this limitation in the claim.

7. Claim 5 recites the limitation "the spacing" in a quantum device. There is insufficient antecedent basis for this limitation in the claim. Claim 6 depends on claim 5, and therefore claim 6 is also indefinite.

8. Claims 7 and 11 recite the limitation "the surface" in a quantum device. There is insufficient antecedent basis for this limitation in the claims. Claim 8 depends on claim 7, and claims 12-16 depend on claim 11, and therefore claims 8 and 12-16 are also indefinite.

9. Claim 11 recites the limitations "the charge wavefunctions" in a quantum device. There is insufficient antecedent basis for this limitation in the claim. Claim 12-16 depend on claim 11, and therefore claims 12-16 are also indefinite.

10. Claim 12 recites the limitations "the potential barrier" and "the barrier height" in a quantum device. There are insufficient antecedent bases for these limitations in the claim. Claims 13 and 14 depend on claim 12, and therefore claims 13 and 14 are also indefinite.

Art Unit: 2815

11. Claim 13 recites the limitation "the relative shapes and sizes" in a quantum device. There is insufficient antecedent basis for this limitation in the claim. Claim 14 depends on claim 13, and therefore claim 14 is also indefinite.

12. Claim 17 recites the limitation "the configuration" in a quantum device. There is insufficient antecedent basis for this limitation in the claim. Claims 18 and 19 depend on claim 17, and therefore claims 18 and 19 are also indefinite.

13. Claim 18 recites the limitation "the environment" in a quantum device. There is insufficient antecedent basis for this limitation in the claim. Claim 19 depends on claim 18, and therefore claim 19 is also indefinite.

Claim Rejections - 35 USC § 102

14. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

15. Claims 1-5 and 7-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Kane (US 6,369,404).

Regarding claims 1-4, Kane discloses a quantum device (Fig. 3) comprising a pair of dopant atoms (^{31}P) (col. 8, line 60) located in an otherwise electrically inert solid

Art Unit: 2815

substrate (5) (col. 7, line 11) in which it is possible to ionise the dopant atoms, wherein the two dopants (^{31}P) inherently produce a double-well electric potential and a charge qubit is realised by a location of one or more electrons or holes within this potential (claim 1), wherein the substrate (5) is silicon (col. 8, line 59), the dopant (^{31}P) is phosphorus and ionisation of one of the donor atoms inherently creates a P-P^+ system (claim 2), wherein the charge qubit may be formed by the location of a single electron in one or the other well of the double-well potential (claim 3), and the charge qubit may be formed in the lowest symmetric or antisymmetric molecular states (claim 4).

Further regarding claims 1, 3 and 4, the claim limitations “it is possible to ionise the dopant atoms”, “a charge qubit is realised by the location of one or more electrons or holes within this potential”, “a charge qubit is formed by the location of a single electron in one or other well of the double-well potential”, and “the charge qubit is formed the lowest symmetric or antisymmetric molecular states” specify an intended use or field of use, and are treated as non-limiting since it has been held that in device claims, intended use must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). A claim containing a “recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus” if the prior art apparatus teaches all the structural

Art Unit: 2815

limitations of the claim. *Ex Parte Masham*, 2 USPQ 2d 1647 (Bd. Pat. App. & Inter. 1987).

Regarding claim 5, Kane further discloses for the quantum device according to claim 2 that a spacing between the P atoms is up to 200nm (col. 8, lines 61-62) (claim 5).

Regarding claims 7 and 8, Kane further discloses for the quantum device according to claim 2 that the two P atoms are buried up to 200nm below a surface of the device (col. 8, lines 60-61) (claim 7), wherein the two P atoms are buried 20 nm below the surface of the device (claim 8).

Regarding claims 9 and 10, Kane further discloses for the quantum device according to claim 2 that the silicon substrate (5) is coated with an insulating layer (6) (col. 8, lines 62-63) to isolate the donor electrons from any surface electrodes (7 and 8) (col. 7, lines 13-15) (claim 9), wherein the insulating layer is SiO₂ (claim 10).

Regarding claims 11-14, Kane further discloses for the quantum device according to claim 2 that gate electrodes (7 and 8) are placed on a surface of the substrate (5) above the donor atoms (³¹P) to allow for external control of charge wavefunctions (claim 11), wherein a first gate (8) is located over a potential barrier, between the two wells, to control a barrier height (claim 12), wherein a second gate (7), or more than one second gate (7), is provided to control relative shapes and sizes of the two wells (claim 13), wherein suitable biasing of the first and second gates (8 and 7) allows one qubit logic operations to be performed (claim 14).

Further regarding claims 11-14, the claim limitations “to allow for external control of the charge wavefunctions”, “to control the barrier height”, “to control the relative shapes and sizes of the two wells”, and “suitable biasing of the first and second gates allows one qubit logic operations to be performed” specify an intended use or field of use, and are treated as non-limiting since it has been held that in device claims, intended use must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). A claim containing a “recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus” if the prior art apparatus teaches all the structural limitations of the claim. *Ex Parte Masham*, 2 USPQ 2d 1647 (Bd. Pat. App. & Inter. 1987).

Regarding claims 15 and 16, Kane further discloses that one or more charge detection devices (SETT) may be provided on the surface of the substrate (5) for qubit readout and to confirm initialization of qubits (col. 8, lines 46-52) (claim 15), wherein the charge detection device (SETT) is a single electron transistor (SET) (claim 16).

Regarding claims 17-19, Kane further discloses for the quantum device according to claim 2 that a configuration comprising two dopant atoms (^{31}P), surface gates (7 and 8) and surface charge detection devices (SETT) may be repeated many times on a single silicon chip (5), allowing for scale-up to a many qubit processor (col. 8, lines 46-52) (claim 17), wherein the device (Fig. 3) is cooled (col. 9, lines 4-5) to ensure

Art Unit: 2815

that the donors (^{31}P) are not thermally ionised and to minimise coupling of the charge qubits to the environment (claim 18), wherein the device (Fig. 3) is cooled to 4K or below (claim 19).

Claim Rejections - 35 USC § 103

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

17. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kane (US 6,369,404). The teachings of Kane are discussed above.

Kane differs from the claimed invention by not showing that the spacing between the P atoms is in the range 20 to 100nm.

The claim is prima facie obvious without showing that the claimed range of the spacing achieves unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105

Art Unit: 2815

USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAY C. KIM whose telephone number is (571)270-1620. The examiner can normally be reached on 7:30 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/J. K./
Examiner, Art Unit 2815
October 22, 2008

/Jerome Jackson Jr./
Primary Examiner, Art Unit 2815